

## Supplementary Information

### Movie 1: Paradoxical stabilization of a moving frame.

The right edge flashes red at the left end of the frame's travel and the left edge flashes blue at the right end. Participants matched the perceived separation between the flashes with the markers on the upper right. In this example, the frame travel is longer than the frame size so the red flash is physically to the left of the blue flash. Nevertheless, blue is seen left of red.

- The movie starts very slowly to make the positions of the flashes clear: red on the left, blue on the right.
- However, after several seconds, when the frame reaches full speed, you may see the blue flash to the left of the red.
- The markers above to the right are adjusted to match the perceived separation.
- The frame will fade out briefly to reveal that red is really to the left of blue.

### Movie 2: Superimposed flashed probes.

The two discs, one red and one blue, always flash at the same location but when the moving frame is visible, they are pulled to the left and right by almost as much as the frame's displacement. This is not affected much by fixation (try fixating the corners of the movie).

- The red and blue flashes are always at the same location.
- When the frame is present and moving, the blue flash may appear to be to the left of the red.
- The markers above are adjusted to match the perceived separation.
- The frame will fade out briefly to reveal that red is physically superimposed on blue.

### Movie 3: Double frame effects.

- Red and blue discs flash in alternation on the left and right of fixation.
- All discs are aligned horizontally. Always.
- Two frames move in opposite directions and pull the flashes apart.
- Eye movements cannot explain the position shifts because the two frame effects are seen at the same time in opposite directions